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Remote SIM card replacement and activation process

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## Remote SIM Card Replacement and Activation process

### Technical Field.

The invention deals with replacement of data processing devices, each data processing device being attached to a respective account identifying a subscriber. The invention particularly applies to SIM (Subscriber Identity Module) card replacement and the corresponding activation process of the new account. Remote SIM Card Replacement and Activation process applies to the GSM (Global System for Mobile Communication) world where SIM plays an important role in identify the subscribers to the GSM network operator for services like voice communications, mobile services and mobile transactions.

In our illustrated example, the account will be identified with a parameter called IMSI (International Mobile Subscriber Identity) known by the skills in the art. Nevertheless, the invention is not limited to this example, any other parameters identifying a subscriber account is part of the invention.

### Prior Art.

In the GSM environment, network operator purchases SIM cards from various SIM vendors in batch and need to provision all the information (Card ID, Account Information, etc) on the SIM card to their network system as well as various backend systems before activating the SIM account. For postpaid subscribers (which the subscribers settle their bill after use by means of account transfer, pay by cheque, etc), this activation can be done when the subscribers register their information at the operator's point-of-sales. For prepaid subscribers (which the subscribers has to pay in advance for the network services), this activation has to be done in advanced so that the card is already activated when the subscribers purchase it from any distribution channel (operator's point-of-sales or authorized dealers).

As new services roll out by the network operators each time, and when these services required the change of the SIM card, operators need to either send the new SIM card to their postpaid subscribers (as the subscriber information is

registered), or ask them to go to their nearest point-of-sales to exchange for a new SIM card. For prepaid subscribers, they have to purchase a new SIM card from the distribution channels to replace the current SIM card.

5 The process and the efficiency of the SIM replacement becomes a hassle when it comes to large amount of SIM cards need to be replaced, and create subscribers inconvenience in most cases. The amount of backend processes involved in the postpaid has been automated as a standard operation at the point-of-sales level, but not applicable to most operators when performing a  
10 remote (outside point-of-sales) card replacement. For the prepaid subscriber's SIM replacement, it is even impossible in most operators when the existing account information is unknown to the network operators. Therefore, it becomes a huge efforts and obstacles for the network operators to roll out new services that require SIM card replacement.

15 Moreover, as operators are under tremendous cost pressure, pre-activating all prepaid accounts is always an issue due to investment in network equipment for pre-load accounts storage before activation. Most common network equipments include the AuC (Authentication Center), and HLR (Home Location Registry) which has only fixed capacity per system for storing subscriber account information, will need to be increased as more and more accounts are pre-loaded into these systems.

#### Summary of the Invention.

25 A remote SIM replacement process is necessary to be in place to resolve the SIM replacement (and perform activation after replacement) issue. The process should ensure the proper security is in place to avoid fraud, and at the same time, should be foolproof without much user inconvenience and involvements. The solution should also enable a remote SIM card activation after replacement  
30 which can help the operators to provide just-in-time provisioning and activating of the accounts to the AuC, HLR and various backend systems. It can thus help the operators to better utilize the investment on the systems' capacity only when necessary.

To this end, according to the invention, the new SIM includes

- 1 A one-time parameter (IMSI/Ki) known from the network (HLR,AuC), said one-time parameter being the active account;
- 5 New parameters identifying a new account (IMSI/Ki) attached to a new data processing system,

According to the invention, the activation steps are the followings:

- 1) When the data processing system is switched on, the one-time IMSI/Ki  
10 is used to logon the network;
  - 2) Upon successful logon to the network, a program stored in the new SIM automatically sends an activation request for activating said new account.
- 15 So that, with the invention:
  - SIM swapping and activation is at the hand of end user.
  - the same One-time IMSI/Ki is used for a set of new cards.

It will be easier to understand the invention on reading the description below,  
20 given as an example and referring to the attached drawings.

In the drawings:

- Figure 1 is a view of a computer system in which the invention can be applied;
- 25 Figure 2 is a conceptual view of the file structure of the new SIM card, in place to facilitate the remote replacement and activation;
- Figure 3 is a view of the information copied from the old SIM card into the new SIM card.

30 Detailed description of examples illustrating the invention

To simplify the description, the same elements illustrated in the drawings have the same references.

Figure1 is a view of a system in which the invention can be applied.

This system includes:

- A old SIM card OCAR
- A new SIM card NCAR
- A SIM copy device
- A mobile phone MOB in which you can insert a SIM card
- The mobile communicates with a SMS center SMSC
- SMS center SMSC communicates with A SIM data management SDM communicating with a plurality of entities able to manage the account attached to each SIM card. Management of a SIM card includes network authentication, mobile localization, etc.

For each SIM card, there are 2 basic elements on the card in order for the network to identify the subscribers; there are the IMSI (International Mobile Subscriber Identity) and the Ki (Authentication Key). The IMSI is serves as the account identifier whereas the Ki is used when the subscriber's mobile station (handset/phone) is requesting to log on to the network. There is an ICCID (IC Card Identifier) on the card also in order for the operator to act as the SIM card ID as it serves as the serial number of the card in most cases.

The network authenticates the SIM card (identified by the IMSI value) based on the authentication result generated by the Ki and the on-card authentication algorithm, for example the Comp128 algorithm defined in the GSM specification. In order for the subscriber to log on to the network, the IMSI and Ki value must be preloaded onto the network's AuC for a successful authentication to be performed. If the IMSI and Ki is not present in the AuC, the subscriber cannot logon to the network due to in-exists IMSI entry. This will be the key in the replacement process that the IMSI, Ki pair of the card being replaced must be removed from the AuC followed by the replacement of the new IMSI, Ki value of the replacement (new) card.

There are two part of the solution, 1) Remote SIM Card replacement and 2) Remote SIM activation.

There are 3 components in the SIM Card replacement process,

- 1) The old SIM card OCAR,
- 2) The new SIM card NCAR, and
- 3) Any form of SIM copy device COP (hereafter refer as 'the SIM copy device') which can read and write SIM data in and out from the old and into the new SIM (e.g. a software on PC with a smart card reader attached, a customized hardware device to read and write onto the smart card).

10

The Old SIM Card OCAR contains the existing account information

The NEW SIM Card NCAR contains the following information:

- 1. The new IMSI , KI in a hidden file ready to be activated
- 2. A One-time IMSI, One-time KI in order for the new card to get the access to the network to perform one-time activation request
- 3. The ability to make phone call to predefined phone numbers only before activation with the One-time account. This One-time account will be described in detail in the next section. Usually, the predefined numbers will be the customer care center number in case for any query.
- 4. A small hidden application with the ability to send out an Activation Request to a dedicated address for account activation by SMS, USSD String, or any other means to inform the backend for such request when the user initiate an Activation Request in the form of menu selection on the phone, or auto-trigger after the One-time account activation.

25

The SIM copy device COP has the capability to copy the following information from the OLD card to the NEW card:

- The ICCID and IMSI from the OLD card to the NEW card hidden file
- The Phonebook entries from the OLD card to the NEW card Phonebook file

30

- The Short Message Service (SMS) entries from the OLD card to the NEW card SMS file
  - And any other customized information from the OLD SIM to the NEW SIM
- 5 The basic idea in remote card replacement is to use the SIM copy device COP to copy all OLD card information (ICCID, IMSI, Phonebook, SMS entries, etc) from the old card OCAR into the new SIM card NCAR so that the NEW SIM can send out an Activation Request to the network with the Old Account information (OLD ICCID, OLD IMSI) and the NEW Account information (NEW 10 ICCID, NEW IMSI). Since the SIM copy device COP also copy the phonebook, SMS entries, etc to the NEW SIM, upon new card activation, the new SIM NCAR will preserve all the old card information with the new services in placed. In our illustrated invention, after the NEW card NCAR sent out the Activation Request, another component at the network side namely "the SIM Data 15 Management System" SDM will process the Activation Request. The SIM Data Management System SDM mainly serves the following purposes:
1. Receive Activation Request from the subscribers;
  2. Deactivate the Old account based on the information received (Old 20 ICCID, Old IMSI) from the subscriber. The deactivation will be done on the AuC, HLR, or any other systems required;
  3. Activation of the New account based on the information received (New 25 ICCID, New IMSI) from the subscriber and provision to the AuC, HLR, or any other systems required.
- With the SIM Data Management System in placed, it is not required to provision all the account information into various system before activation. The activation will be done in a just-in-time fashion which can saves quite an amount of space on the AuC and HLR especially.
- The reason why a one-time IMSI/Ki is used instead of the new IMSI/Ki is to ease the number of activated subscriptions. One advantage is that the SIM Data Management Server SDM can determine in which HLR/AuC the new IMSI/Ki resides at the time of activation. It allows better management of HLR

subscription capacity. The one-time IMSI/Ki, as far as I understand, is shared with multiple cards.

The purpose of the new card before activation is to send the activation request.

- 5 That's why every new card can use the same number as long as the information sent out from the new card NCAR contains the OLD card IMSI and NEW card (SCB) embedded IMSI for reference.

10 After all, this solution tries to minimize any user error/involvement by making use of OLD card information when the NEW card is inserted into the handset after information transfer from the device or any terminal/reader. The followings describe in detail of what is being done in each of the components mentioned in the previous sections.

#### Step 1: Subscriber Replace the Old SIM Card.

- 15 A subscriber purchase or receive a new SIM card from the operator or from the operator's distribution channel.

20 Thanks to the SIM copy device from the distributor or purchased/sent together with the new SIM card NCAR, the subscriber can copy all the existing (also refer to as "old") information from the existing (or "old") SIM card to the new SIM card NCAR.

Figure 2 gives an example of the new SIM file structure in place to facilitate the remote replacement and activation.

25 Figure 3 is a view of a part of the files stored in the old card OCAR and the new SIM card NCAR. On the left of this figure, we have represented the old SIM file structure and on the right the new SIM file structure (we have only represented the related files). More particularly, on figure 3, arrows indicate what is the information copied from the old OCAR into the new SIM card NCAR. The SIM copy device COP will copy the following information from the old SIM to the new SIM according to the location in the previous table. In our example, the One-Time IMSI and Ki is an existing account on the network for all the new cards to logon to the network for Activation Request. The account shall not be able to make any phone calls thanks to the network setup as well as on card FDN (Fixed Dialing Number) enabled for Customer Care center only.

**Step 2: Subscriber Activates the New SIM Card**

In our example, the subscriber will put the new SIM card NCAR in the mobile device MB to start the first Activation Request. Upon Insertion of the new SIM

- 5 card NCAR, the SIM card and the Auto-Activation application will perform the following steps:

1. The new SIM Card NCAR will Authenticate with the network using the One-time IMSI and the response calculated from the One-time Authentication Key,

10 Ki

2. Upon successful logon to the network, in our illustrated example, the Auto-Activation application will send out a Activation Request to the SIM Data Management Server SDM connected to the SMSC. The information (with encryption and checksum) the application will send includes for example

15 - The Old ICCID and the Old IMSI in the temporary file that is to be disabled;

- The New ICCID and the New IMSI from the hidden file that is to be enabled;

For security reason, old/new Ki will not sent out at any time by the applet; Only IMSI, ICCID will be sent.

20 3. Upon successful sending of the Activation-Request-SMS, in our illustrated

example, the Auto-Activation application will exchange the One-Time IMSI and One-Time Ki with the New IMSI, and New Ki in the hidden file to replace the existing IMSI and Ki value. It then enables the ADN and disables the FDN.

25 In our example, It will prompt the user to "Activation in Progress" and ask the

user to Switch off and on the phone in some minutes. The new SIM will wait for the SIM Data Management System to activate the account.

**On the SIM Data Management SDM Side, the action will be as follows:**

- 30 1. The SIM Data Management SDM received the Activation Request, decrypt the information and check against the checksum for validity. It then looks up from the other network repository the account information in order to deactivate the account.

2. There are 2 approaches the network operator can take in regards to the Old account IMSI/KI deactivation and New account IMSI/KI activation:

A- Deactivate Old Account and Activate New Account:

In this case, the old account information will not carry forward to the new account and the SIM Data Management System SDM simply issue commands to various systems like, AuC, HLR, a Customer Care CCR, Billing System BS, etc, to deactivate/remove the old account and activate/create the new account in the above systems

B- Change Old Account and Carry Forward to New Account:

In this case, the old account information will carry forward to the new account and the SIM Data Management System SDM simply issue commands to various systems to carry the old account information to the new one and replace the Old account information in the HLR, AuC by the New account.

3. Advantageously, upon successful deactivation Old Account and activation of the New Account, the SIM Data Management System SDM can send for example an optional SMS to confirm the activation to the subscriber. If the SMS is successfully delivered to the handset within a predefined period, we can record it in the system a successful activation has been carried out.

4. If there is any failure occurred during the 1) deactivation, 2) activation, or 3) sending of such optional Confirmation-SMS, a proper exception handling process can be defined by an appropriate workflow — like sending an alarm to the Customer Care to investigate and take corrective measures on the recovery procedure at the backend.

Figure 1 also gives a view of the different steps. Some arrows couple with a respective number (1 to 6) indicate the direction of each message. The different steps are:

1. The SIM copier COP copy the old ICCID, IMSI to the New Card.

2. NEW SIM card NCAR is inserted into the phone MOB, logon to the network using the One-time a/c. It then Send out the old and new card information in step 3. Upon successful sending, 'New IMSI' and 'KI' will be overwritten to replace the existing One-time account waiting for activation.

10

3. The card NCAR sends out the Activation Request with "Old ICCID/IMSI, New ICCID/IMSI" information to the backend using this One-Time a/c.
4. A dedicated SMSC receives the Activation Request, and pass the request to SIM Data Management SDM.
5. SIM Data Management system SDM process the request, fetch for the corresponding account information from the Old and New ICCID/IMSI, and perform backend replacement/activation process.
6. SIM Data Management system SDM updates various system, including AuC for Card Activation.

10

**CLAIMS**

1. Data processing device, in particular a smart card, including a  
5 microcontroller and being able to communicate with at least one remote system  
(HLR, AuC) distributed on a network; said data processing device and said  
remote system being able to store parameters (IMSI/Ki) identifying a user  
account belonging to a subscriber, characterized in that said data processing  
device includes:
  - 10 A one-time parameter (One-Time IMSI/Ki) being the active account  
attached to said device (NCAR) designed for a one-time use,
  - A permanent parameter identifying an account (new IMSI/Ki) attached to  
said data processing device (NCAR), said permanent parameter being  
deactivated,
- 15 Said one-time and permanent parameters being also stored in said at least one  
remote system.  
And in that said microcontroller is programmed for performing the following  
steps:
  - a) When said data processing device (NCAR) is switched on, the one-time  
20 parameter (one-time IMSI/Ki) is used to logon the network;
  - b) Upon successful logon to the network, the one-time parameter (one-time  
IMSI/Ki) is exchanged with the permanent parameter (new IMSI/Ki) said  
permanent parameter becoming the permanent active account instead  
of the one-time parameter.
- 25 2. Data processing device according to claim 1, characterized in that said first  
device and said at least one remote system also store a parameter identifying a  
current active account (old IMSI/Ki) attached to a second data processing  
device (OCAR) to replace, and in that upon successful logon to the network, a  
30 program automatically stored in said first device (NCAR) sends an activation  
request for exchanging the IMSI/Ki from the old for the new one in said at least  
one remote system (HLR,AUC), the current active account (old IMSI/Ki) being  
deactivated.

3. Data processing device according to claim 2, characterized in that said activation request includes at least one old parameter (old IMSI) and/or at least one new parameter (new IMSI) for identifying the device (NCAR) requesting an account activation.
4. Data processing device according to claim 1, characterized in that said one-time parameter (One-Time IMSI/Ki) is the same for a set of data processing devices (NCAR) replacing a respective old data processing device (OCAR).
5. Data processing device according to claim 1, characterized in that the subscriber switches on said data processing device (NCAR).
6. Data processing device according to claim 2, characterized in that, after receiving the activation request from said first device (NCAR), it sends commands to said at least one remote system for exchanging the current active account (old IMSI/Ki) corresponding to the second device into the new active account (new IMSI/Ki) corresponding to the first device (NCAR).
7. Data processing device according to claims 1 or 2, characterized in that the logon step a) is performed in a centralized remote system (SDM), and in that, after receiving the activation request from said device (NCAR), said centralized remote system (SDM) sends commands to said at least one remote system for exchanging the current active account (old IMSI/Ki) corresponding to the second device into the new active account (new IMSI/Ki) corresponding to the first device.
8. Data processing device according to claim 1, characterized in that, step b) is performed in said device by mean of an auto-activation application executed after receiving a message from the network informing a successful logon.

**Abstract**

5 Data processing system, in particular a smart card, including a microcontroller and being able to communicate with at least one remote system (HLR, AuC) distributed on a network, said data processing system and said remote system being able to store parameters (IMSI/Ki) identifying a user account belonging to a subscriber, characterized in that said data processing system includes:

- A one-time parameter (One-Time IMSI/Ki) also stored on said at least one system (HLR, AuC), said one-time parameter being the active account and designed for being used one time,
- 10 - A permanent parameter identifying an account (new IMSI/Ki) attached to said data processing system (NCAR), said permanent parameter being deactivated,

Said one-time and permanent parameters being also stored in at least one 15 remote system,

And in that said microcontroller is programmed for performing the following steps:

- c) When said data processing system (NCAR) is switched on, the one-time parameter (IMSI/Ki) is used to logon the network;
- 20 d) Upon successful logon to the network, a program exchange the one-time parameter (IMSI/Ki) with the permanent parameter (IMSI/Ki) both on said data processing system (NCAR) and on said at least one system (HLR,AUC), said permanent parameter becoming the permanent active account instead of the one-time parameter.

25 **Figure 1.**



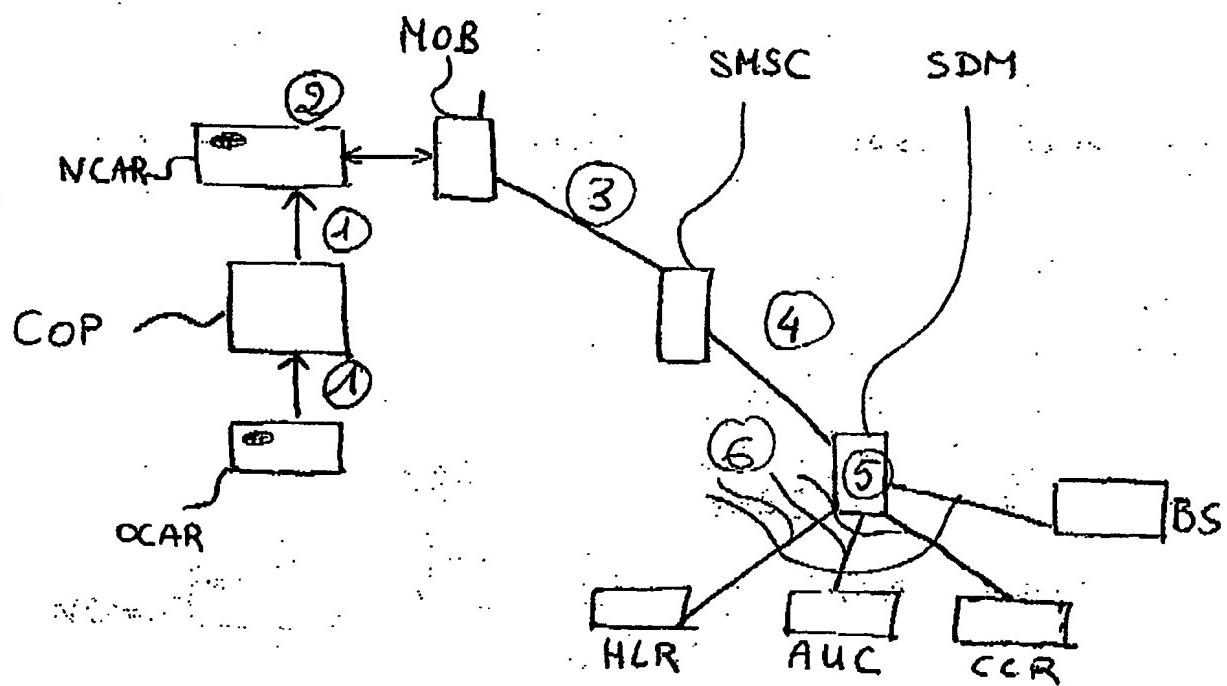


Figure 1

Old SIM Source File	Action	New SIM Destination File	Changes on the New SIM	Description
GSM ADN File	<b>Copy</b>	GSM ADN File	Phonebook Copied	Phonebook
GSM ADN File	<b>Disable</b>	GSM ADN File	Phonebook Disabled	Phonebook
GSM FDN File	-	GSM FDN File	Customer Care number preloaded	Fixed Dialing Number
GSM FDN File	<b>Enable</b>	GSM FDN File	Fixed Dialing Number Enabled	Fixed Dialing Number
GSM SMS File	<b>Copy</b>	GSM SMS File	SMS Copied	SMS
GSM ICCID File	<b>Copy</b>	Temporary File	Old ICCID value stored	Old IC Card ID
GSM IMSI File	<b>Copy</b>	GSM ICCID File	ICCID Value preloaded	New IC Card ID
GSM IMSI File	<b>Copy</b>	Temporary File	Old IMSI value stored	Old International Mobile Subscriber Identifier
GSM IMSI File	-	GSM IMSI File	One-time IMSI Preloaded	International Mobile Subscriber Identifier
GSM IMSI File	-	Hidden IMSI File (Read Protected)	New IMSI Preloaded	N/A
GSM Ki File	<b>Un- touch</b>	GSM Ki File	One-time Ki Preloaded	Authentication Key
GSM Ki File	-	Hidden Ki File (Read Protected)	New Ki Preloaded	N/A
GSM Ki File	-	With or without menu for activation request upon One-Time account activation or manual selection	Auto-Activation Application Preloaded	N/A

Figure 2

3/3

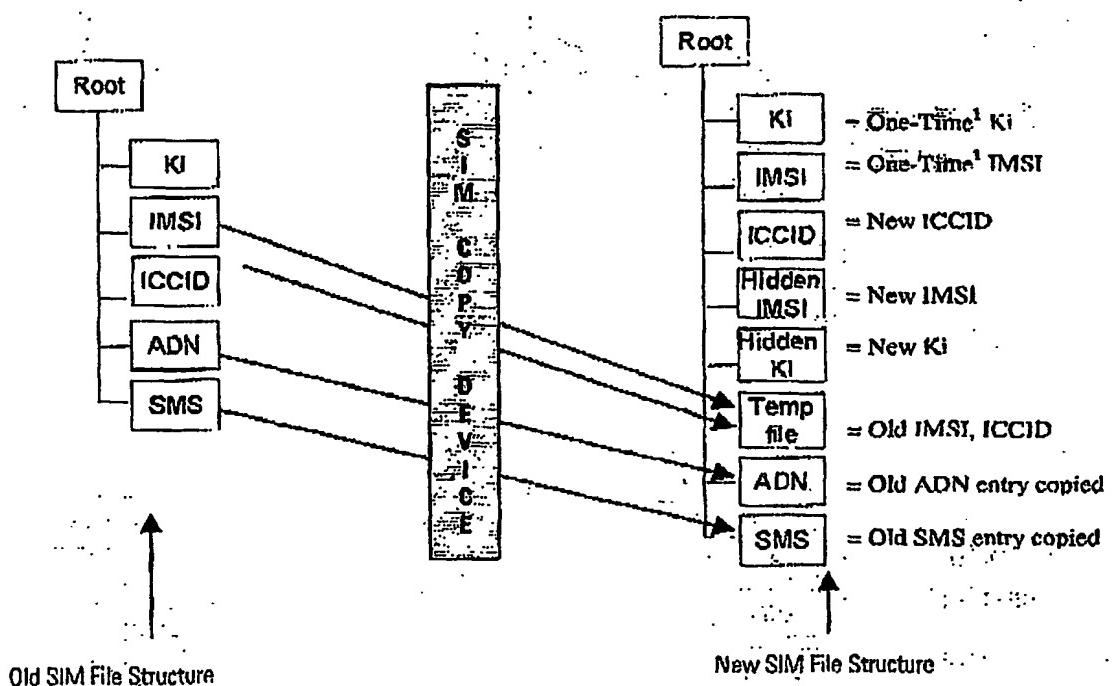


Figure 3

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